# Open Systems Joint Task Force Gets the Word Out

## PMs Now Expected to Consider Using Open Systems

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Department of Defense Regulation 5000-2R, Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition, states that DoD program managers must give more consideration to Open Systems during program planning and system engineering. The Open Systems Joint Task Force, which falls under the Office of the Under Secretary of Defense for Acquisition and Technology, faces the daunting challenge of relaying this message to DoD program managers.

One avenue the Task Force used to spread the message was a recent seminar entitled: "Open Systems Acquisition of Weapon Systems – A How-To Workshop." The three-day seminar covered a variety of topics related to Open Systems. This article addresses many of the questions that were raised at the seminar.

### Defining Open System

Before getting into a discussion of the seminar, understanding the definition of an Open System is important. Many people believe that Open Systems pertain only to electronics, computers, or communications. While used extensively in these areas, the intent of DoD's policy is to apply Open Systems to all types of weapon systems. Open Systems rely upon widely used, currently available and economical components and subsystems to keep procurement and support costs low. At the same time, an Open Systems approach shortens development time and integrates available technology, without developing new or unique interfaces among components. Open Systems focus on interfaces used in programs. To be called "Fully Open," the interfaces, the standards that define the interfaces, and the components that implement the interface standards must meet the criteria listed in Figure 1.

Open Systems employ fully defined, available-for-public-use interfaces that are maintained by consensus. An Open Systems approach also considers the business implications of different open interfaces – such as the relative market acceptance of products that use the open interface. This marketplace emphasis helps lower the cost and increase the availability of replacement parts to sustain the Open System throughout its life cycle.

Open interfaces permit industry to build products that meet standard accepted form, and fit parameters. When we employ standardized interfaces, modules become "portable" for wide use in a variety of systems. This aspect of Open Systems further reduces costs by leveraging the advantages of mass production.

Modularity allows the internal design details of a system's physical components – hardware and software – to change with time. New technology still fits into the system by conforming to the standard interfaces. Changes can occur without significant redesign effort, high costs, or long timelines that we tend to see in unique, optimized systems.

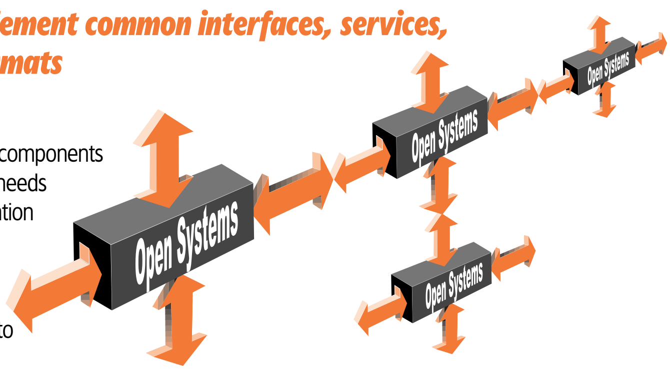
### The Automobile Tire — A Simple Example

Let's take an automobile tire as an example. A variety of tire sizes are in the market today, but only a few sizes will fit your vehicle. Let's assume your current tires are P205/55ZR16. When you

FIGURE 1. **Open Systems Definition**

***Open Systems implement common interfaces, services, and supporting formats***

**Open System**
- A collection of interacting components designed to satisfy stated needs with the interface specification of components --
  - Fully defined
  - Available to the public
  - Maintained according to group consensus
- In which the interactions of components depend on the interface specifications, and the components conform to the interface specifications.




**An Open System Approach ...**
- Is an integrated technical and business strategy,
- Uses modular hardware and software design,
- To buy, rather than build.

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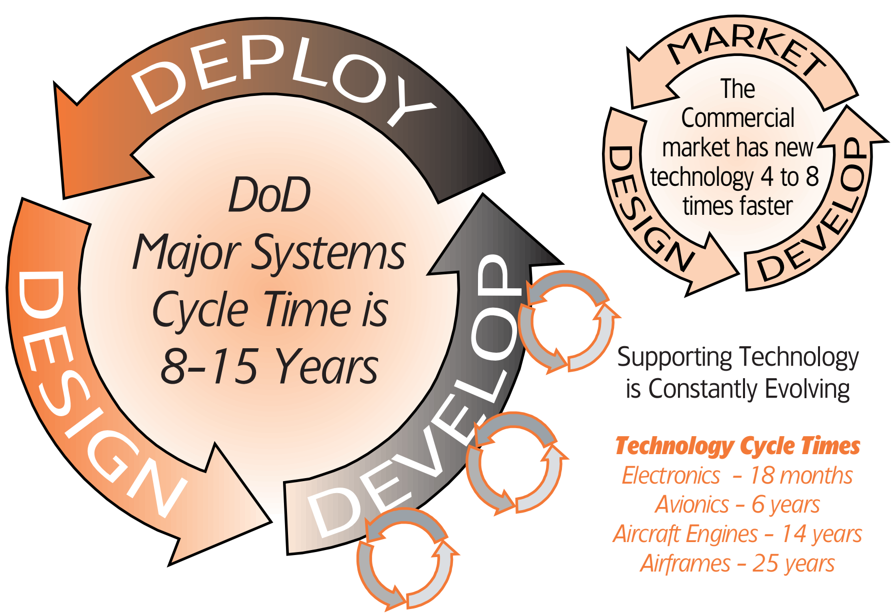
FIGURE 2. **Technology Turnover Rates**




Open Systems reduce the probability of fielding obsolete equipment, or having to redesign your system for upgrades and modifications in the future.

need replacement tires, we know that buying the exact same type and brand from the same manufacturer is not necessary to make your car run properly.

Using the P205/55ZR16 size designator (the open interface specification), you can select from a number of different brands that will fit on your car's existing wheel rims. If you do not need high-speed performance, you might choose a less-costly tire with a lower top speed rating. You have the option to select tires with a different tread pattern for lower noise or smoother ride. You might want a tire that gives more traction in the rain or snow. As new materials transition into tire manufacturing, you do not have to reengineer the car; you simply buy a new set of tires that fits. The message here is that open interfaces and the marketplace give us a variety of choices as we maintain our car over time.

## How Do Open Systems Affect Cost As an Independent Variable (CAIV)?

Open Systems' use of standard interfaces, similar to size designations in the area of tire technology, allows us to make trade-offs from multiple sources. When alternative products are available that fit properly, we can consider performance against cost among the candidates that satisfy the standard interface. This is how Open Systems facilitate the application of CAIV.

Open Systems take advantage of the evolution of products that use a slowly changing or constant interface. So as time goes on, ingenuity, efficiency, and new processes applied to modules will improve their performance, longevity, or reliability. These modules, when using a standard open interface, still fit into the older systems, providing continued, economical sustainment support and a potential for improved performance. Think of the implications this concept might have on a power supply for a missile; a filter for an armored vehicle; a brake pad for an aircraft; software; or other components in Defense programs.

## How Do We Manage Changing Technology?

In the past, good configuration management meant that the exact same part, subsystem, or software was maintained over the system's life cycle. Changes were difficult and costly. Today, our weapon systems must last for extended life cycles, and one challenge is dealing with obsolescence and changing technology during the sustainment phase.

Figure 2 illustrates that technology is always changing. Some product lines, called "Domains" in Open Systems terminology, change more often than others. In some domains, we face obsolescence of technology even before our system can complete one part of the design or production phase of its life cycle.

How do we buy spare parts 30 years from now, if the technology changes every 18 months? This is a real issue that confronts configuration managers and logisticians—it is also an area where an Open Systems approach can help.

The answer is to use Open Systems to standardize the interface, not the detailed design of each module. When we need replacement parts, we carefully select solutions that meet the interface. The new modules must also provide the minimum level of functionality required in our systems. Even in the high-turnover electronics domain, the interfaces tend to be long-lived. By using configuration management only on the interfaces and not on the modules, we can take advantage of changing technology.

An added benefit is that the business aspects of Open Systems—market acceptance of the interfaces—will help ensure that multiple sources (each having their own "implementation," or point design) will fit the interface in the system. Availability of competitive sources is the direct connection between Open Systems and CAIV.

A well-designed Open System also allows easy future insertion of new technology, avoiding obsolescence and lack of sources. It also provides the opportunity for component intra-operability, using the same interface among multiple systems for further economy and supportability advantages.

## What is an Architecture?

A central concept to Open Systems design is use of an "Architecture." Developing the architecture is only one of a series of steps in our process, but the term "Architecture" is widely used. Let's look at what this means in Open Systems' terminology.

FIGURE 3. **Architectures**

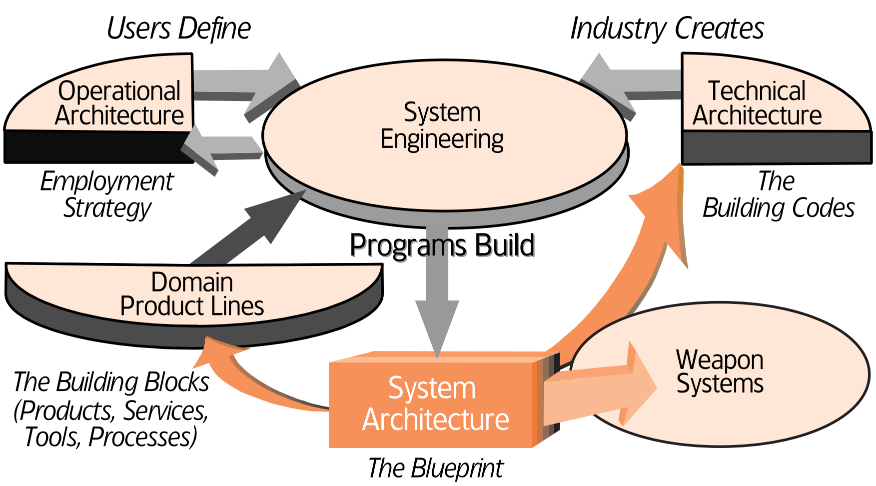



Figure 3 shows several types of architectures in the design of weapon systems. The operational architecture contains the interoperability requirements of the weapon system with all external activities. Much of the operational architecture is described in requirements documents, such as command and control interfaces, interaction with other weapon systems for joint operations, and Service-wide or DoD logistics constraints.

The technical architecture, a set of general interfaces that can be applied to the system, typically contains a set of interfaces that are approved for broad use. Examples within DoD are the Joint Technical Architecture (JTA) and Technical Architecture for Information Management (TAFIM).

Domain product lines add very specific types of interfaces relevant only to the type of system being built, i.e., interfaces for aviation applications when the system is an aircraft.

With an Open Systems approach, the systems engineering process takes the defined operational architecture, selects appropriate interfaces from the technical architecture, and tailors interfaces from the domain-specific product lines to build a unique system architecture. Think of the system architecture as a skeleton of interaction and interfaces. When modules (comprising the subsystems and components) are integrated into the architecture, they add functionality, making the system complete.

The architecture may be "Fully Open" or be somewhat less than open by using unique or proprietary interfaces in the design. We should focus on maximizing the degree of openness to achieve the benefits covered earlier.

Building a system architecture is a complex proposition. One of the important parts in our seminar was to prioritize Open System design efforts to help achieve the highest payoff for the constraints of limited development time or limited design costs.

Figure 4 illustrates our prioritizing process for Open Systems design efforts. When you perform analysis and interface selection activities as your first priority, you work on areas that receive the most benefit. These include domains with rapidly changing technology, areas where we know the system must change over time, and areas that have high life cycle cost implications (high cost items, high maintenance items, and high replenishment rate components).

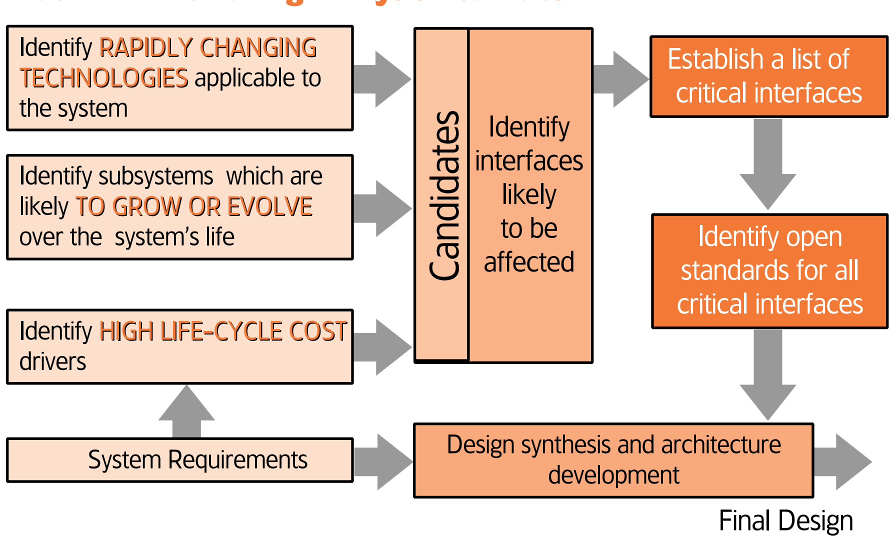
## What Sort of Decision Tools Can We Use?

To help compare and select interfaces for use in system architectures, we employ a simple tool called the "Quad Chart" (Figure 5). This tool helps us analyze and compare relative merits of important interfaces. Although the tool is very basic, the information needed to use it requires some research as well as an understanding of all possible types of interfaces in the situation. The technical architecture and domain product lines are sources for this information.

The Quad Chart uses two measures to compare alternatives — openness of the interface standard and the extent that the interface is accepted in the marketplace. Remember, an Open Systems approach is an integrated technical and business strategy.

The horizontal axis ranges from standards that are "closed," or proprietary on the left side, to fully open standards on the right side. In between is a gray area that covers interface standards

FIGURE 4. **Prioritizing Analysis Activities**



controlled by military, federal, standardization agreement (NATO), informal commercial partnerships, informal groups, domestic formal technical societies, and international organizations' standards activities. Each of the possible interfaces is controlled by the entity with some degree of openness that we plot on the horizontal axis. When using this tool, we first determine how "open" a candidate interface is; the next step is a bit harder.

We can measure the market acceptance in several ways: current sales of products that use the interface, volume produced, market share, or total-installed base are all good indicators. These data are not easy to find, but making the best choice is essential. This type of market analysis is necessary for each and every candidate interface that we plot on the chart. If there are a dozen candidates, this can take time to research. This time-consuming step is one reason we first prioritize where to apply the Open Systems design process (Figure 4).

The Quad Chart helps narrow a field of potential interfaces. Obviously, a candidate in Quad 4 is a better choice than one in Quad 1. But when we compare critical system interface alternatives, several other considerations apply. Before selecting the interface to incorporate into the architecture, we need to investigate the maturity of the interface standards, available testing, verification and certification levels, and external constraints such as mandated commonality with other military systems.

## Some Words of Advice and Caution

One essential element that we did not address here is the system's threshold performance and how its functionality results from implementation of system modules. System-level, subsystem-level, and component performance is defined in the specification process, along with the interfaces that we discussed. Open Systems assure that alternatives are available that will fit! However, you must be aware that an Open Systems approach is only one part of an overall process that determines how well the system works. Open Systems consider business and technical trade-offs. This means that highly optimized, unique (and possibly proprietary) interfaces are not part of a true, 100-percent pure, Open System. In some military weapon systems, highly optimized and unique interfaces are necessary. Accepting anything less will not satisfy the users' needs.

Open Systems may not be the best choice for every interface in all weapon systems. However, a pragmatic Open Systems employment strategy will identify the few areas where specific, highly optimized interfaces are absolutely necessary. In most situations, the reduction in development and the life cycle benefits of an Open Systems approach are worth the effort.

An Open Systems approach takes time and effort during the system design stages. But experience shows that with faster system development cycles, lower total ownership costs, increased performance over time with new technology, and minimal impacts of parts obsolescence, "Open" weapon system management is easier in the long run.

## Open Systems Approach Here to Stay

In this article, we described the basics of an Open Systems approach to weapon system acquisition. Open Systems focus on the interfaces, which are one part of the technical description of a system.

Central to an Open Systems approach is the use of architectures that define standard interfaces that change very slowly. Modular designs, when applied in concert with an open architecture, result in lower development costs and timelines, while also establishing an evolutionary path for easier life cycle support.

**Editor's Note:** The author welcomes questions or comments concerning this article. Contact him at **mgillis@brtrc.com.**

### OS–JTF

The Open Systems Joint Task Force (OS-JTF) was formed in September 1994 to sponsor and accelerate the adoption of Open Systems in weapons systems and subsystems electronics to reduce life cycle cost and facilitate effective weapon system intra- and interoperability.

The OS-JTF is chartered as a cooperative effort of the Department of the Army, the Department of the Navy, the Department of the Air Force, and the Office of the Under Secretary of Defense (Acquisition and Technology).

See the OS-JTF Web site at **http://www.acq.osd.mil/osjtf.**

FIGURE 5. **The Quad Chart**